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AUTHOR Allen, Jeanne Thomas
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ABSTRACT

The tremendous surge of investment capital and research development enjoyed by television under the strong incentives provided by World War II probably resulted in the development of a commercially exploitable television system much earlier than would have been possible otherwise. Cooperation between government and industry in this research and development effort during the war was the context for television's rapid diffusion to the American public in the years after the war's close, and the industry as a whole reaped the benefits of the war innovations. Television receivers for American homes became widely available in the 1950s following a wartime freeze on commercial exploitation, with the five-year period after V-J Day producing the largest financial returns to manufacturers in the history of the industry. The war experience provided two significant directions to the United States and international television history, i.e., the impact of military interest in television for design, research and development, and the informing influence of corporate/government cooperation in shaping both non-military domestic commercial broadcasting and commercial television. Cultivated in the context of commercial sales and military control, the essence of televisual design in the United States is its one-way-ness and its capacity for remote control both in terms of sales persuasion and control in non-peer power relations. (28 footnotes) (CGD)

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Television's Take-Off: Electronics, The United States and World War II

Jeanne Thomas Allen

Paper presented to the 1986 International Television Studies Conference

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Television's Take-Off: Electronics,
The United States and World War II

Jeanne Thomas Allen
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This paper addresses an apparent contradiction between the common sense truism that war produces innovations in communications technology and the fact that little if anything is popularly known about the military context for television innovation. In the popular mind television is synonomous with broadcasting, and television receivers in American homes were not diffused widely until the 1950's following a wartime freeze on commercial exploitation.

Television broadcasting historians, Sydney Head, Eric Barnouw, Kittross and Sterling all describe this period as one of relative quiescence. Head claims that while the 1930's saw important technological advancement particularly by the RCA team headed up by Vladimir Zworykin, television development had to be shelved five months after the Japanese bombed Pearl Harbor, as the production of consumer electronics was enlisted into the war effort with civil defense programming the only broadcasting by the six experimental stations that remained on the air.[1] Barnouw briefly alludes to the intense technical development with the image-orthicon and color experimentation as well as the "jockeying for position" of RCA and CBS but notes the bleakness of the "skeleton programming" that stations offered to 10,000 television set owners while the boom was put in storage during the war.[2] While Kittross and Sterling acknowledge the hiatus as a period of learning, they mention only the military's knowledge of higher-band television frequencies and comment: "the green light given to television in mid-1941 turned to red on May 12, 1942, when a War Production Board order, implemented by the FCC, forbade building stations so that materials could go to the war effort. . . television in effect marked time behind the scenes during the war, planning for the day when the light would turn green again."[3]

Seeing World War II as a period of broadcast programming inactivity is also questionable,[4] but television programming is not the subject of this address. Significant technological innovation and relations between private industry and the federal government is. The $10 million in manufactured television equipment from RCA alone, authorized by the

Office of Scientific Research and Development, would suggest that television, like so many other areas of electronics, enjoyed a tremendous surge of investment capital and research development under the strong incentives that the war provided.[5] At the beginning of the war, television lacked high powered transmitters for large areas which could use all FCC assigned broadcast frequencies, coaxial cable lines which could carry the television signal without distortion, flexible mobile cameras which did not require an excessive amount of light, and bright picture tubes and transmission methods that eliminated 'ghosting'.

This paper will briefly outline some ofthe developments in television technology that occurred during the war and discuss the significance of the cooperation between government and industry which was the context for television's rapid diffusion to the American public in the years after the war's close. The industry as a whole reaped the benefits of the war innovations; the five-year period after V-J Day produced the largest financial returns to manufacturers in the history of the industry.[6] Without the war and the government's influx of money for research and development, it may have taken much longer to develop a commercially exploitable television system. By the early 1950's television was selling at the rate of five million sets per year,[7] not only selling itself but an array of consumer products which kept post war economic recession at bay.

I will outline two significant directions the war experience provided to United States and international television history: the impact of military interest in television for design, research and development and the informing influence of corporate/government cooperation in shaping both non-military domestic commercial broadcasting and industrial television.

For this conference's constituency of social scientists and post-Althusserian critics, this topic addresses two gaps: technological history (the burial of the apparatus Comolli noted years ago in film study) and political economy. The latter is rarely acknowledged in the pluralistic model of the dominant social science paradigm or the phenomenological, formalist and deconstructive modes of contemporary Continental criticism. I hope to demonstrate in passing how important this neglect has been in eliding a fundamental aspect of television and cultural history.

Let me briefly outline some of the areas of television research in the war years in order to fire your imaginations with the television presence which the war agenda spawned. Television equipment was used to pilot boats loaded with explosives against enemy targets; to guide free-falling, radio-controlled aerial bombs, flying torpedos, and expendable assault planes; to spot enemy artillery fire; to locate enemy targets; to survey enemy terrain; to transmit maps, messages and documents between fighting vessels; to interconnect the chief compartments of naval vessels; and to monitor manufacturing and other processes at points where personal observation would prove fatal. Light-weight cameras were developed sensitive enough to televise in moonlight or by the illumination produced by a lighted match.

Among the numerous actual combat applications of television, the Armed Services sent the "Castor" group to England in June 1944 to equip B-17 and B-23 bombers with radio control and television apparatus for direct assault against enemy targets. These bombers carried as much as 14 tons of high explosives with television assisting the control crews in guiding them to their targets. Television-equipped GB-4 glide bombs were directed by radio and television against the German submarine pens at La Pallice, France and the German rocket launching emplacements around Calais. These targets were approached over water and for tactical reasons the bombs were launched at an altitude of 20,000 feet.[8]

In August 1944, a Navy television-equipped drone plane, loaded with high explosives, was successfully directed against Japanese shipping in the Solomon Islands. The Navy sent a television-equipped drone against a Japanese radar station and an anti-aircraft emplacement in a South Pacific Island, both of which had come through the ordinary bomber attacks of the Navy unscathed. NBC engineers developed Project "Ring" with the Navy Department --the Bureau of Ships and the Bureau of Aeronautics -- for long range, high-altitude reconnaissance operations focusing on high definition pictures. Initiated in 1942, "Ring" was placed in the nose and waist of a bomber to assure wide coverage and relay pictures instantly back to ships or receiving stations.[9]

Most spectacular perhaps was the application of television during the first atom bomb tests at Bikini Island in the Pacific in 1947. Radio and television controlled pilotless planes flew through the atomic cloud generated by the explosion and sampled its contents. Television receivers

in the planes were equipped with motion picture cameras to record whatever the television cameras transmitted. The television cameras at Bikini not only operated unattended before the explosion but during it and after, for several hours. At the time of the explosion about 70 planes were in the air over and near Bikini, each performing on a split-second timetable and each receiving orders and information by radio. The explosion itself took place in a millionth part of a second. The application of television in directing battles or "task force TV" was demonstrated in 1948 in a series of Naval maneuvers that involved a mock attack by Navy planes. Ship to shore telecasts were transmitted over a distance of 200 miles.[10] The technology of television then was not so much interrupted by war as shaped by its appropriateness for wartime objectives.

When does this shaping of television technology begin? If we are to be specific to the apparatus we might begin with Vladimir Zworykin's patent for the iconoscope as well as C. Francis Jenkins' mechanically scanned television and H. E. Ives' complete electronic television system for AT&T in the 1920' Sarnoff's self-constructed persona as "the great visionary", like Edison's but without inventive ability, perpetuates his vision of television as the eye equivalent of radio. A Sarnoff memo of 1923 reputedly anticipated <u>television's commercial significance</u> just as the Music Box memo of 1915 was supposed to foresee radio in the home. In a letter of intention to patent, Edison, previous to Sarnoff, claimed "the motion picture will do for the eye what the phonograph did for the ear."

Biographer Eugene Lyons claims that Sarnoff spoke to the Army War College in 1927 about the uses of the 'television eye' in future war operations.[11] He forecast the use of television in military operations "transmitting a direct picture of the enemy's terrain, thus enabling greater accuracy in gunfire," claims his personal historian/publicist, E. E. Bucher.

AT&T communicated across phone lines with televisual accompaniment in 1927 and in November 1929, Zworykin exhibited and explained his television camera tube at a convention of the Institute of Radio Engineers at Rochester, New York, the first public demonstration of an iconoscope geared to a cathode ray tube.

The earliest positioning of television communication in a military context with engineering detail is Zworykin's memoradum to Sarnoff on April 25, 1934. It describes the control of guided missiles using information obtained by television. The torpedo or bomb described should be equipped both with automatic pilot control and remote radio control with the instrument and target data supplied by an iconoscope camera and transmitter in the piloted weapon. Television information would be of two kinds: 1) actual views of the target sighted upon by means of crosshairs; and 2) the readings of instruments in the piloted weapon, given by the position of bright spots on the edges of the picture and read on scales attached to the receiving tube in the control ship. This latter feature is designed to facilitate the checking of instruments in the torpedo prior to release and also while in flight when actual target view is obscured and the automatic pilot is in control.[12]

Zworykin's rationale for the first guided missiles significantly appears in this 1934 statement as the following:

> ...these methods... can be used efficiently only by trained personnel at a comparatively close range, thereby being subjected to anti-aircraft gun-fire. Both radio and automatic-controlled planes lose their efficiency as soon as they are beyond visual contact with the directing base. The solution of the problem evidently was found by the Japanese, who, according to newspaper reports, organized a suicide corps to control surface and aerial torpedoes. The efficiency of this method, of course, is yet to be proven but if such a psychological training of personnel is possible, this weapon will be of the most dangerous nature. We can hardly expect to introduce such methods in this country, and therefore have to rely on our technical superiority to meet the problem.[13]

(Shades of Peter Temin's thesis on American nineteenth century industrial technology as a response to American labor scarcity.)

Consider how closely the following technical report of the OSRD repeats this conception of motivation and design Zworykin offered in 1934:

> The same urge that prompted the Japanese to inaugurate their program of suicide missiles prompted effort in the United States to undertake the development of guided missiles equipped with television. Under the Japanese type of thought, it appeared simple and appropriate to provide a missile with a trained pilot and to expend him against a major target. Under American thinking it appeared that the same objective could be obtained by removing the pilot to a relatively safe location providing him in the missile with television to see the terrain under attack and with a radio link to execute his commands.
>
> Under each culture it was realized that such missiles are expensive, but as the Japanese were prepared to expend trained personnel against major targets, so it seemed appropriate for our Services to expend major logistic effort against targets of crucial importance. The solution of the problem was less simple than either nation realized. The efforts of the suicide pilots were not uniformly crowned with success, and for exactly similar reasons efforts at remote control of missiles with the aid of television had not been successful as the war closed. The problem of flying a missile by remote control is not easily solved.[15]

What seems significant here is not only that the first rationale for military television in the technical reports of the Office of Scientific Research and Management was Japanese Kamikaze Corps, but that the prologue positions the ethics of remote control electronic annihilation as defensive and and expression of the high value placed on human life. The 'cheapness of life' philosophy of 'the enemy' is pitted against the labor-saving, life-saving tradition of American automation. By the end of the war, the United States would drop not just one but two atomic bombs on high density civilian targets and then for the first time itemize and estimate the consequences of such bombing for human life. The U.S. government used the atomic bomb neither to deter the Japanese government from continued warfare nor as a form of intimidation on limited oceanic targets preliminary to civilian bombing.

(One thinks of Peter Davis' "Hearts and Minds" [indeed of the role of film and television in the Vietnam War and the domestic resistance movement] particularly the remarks of General Westmoreland commenting on "the

Oriental's lack of reverence for life" contrasted with the tearful remarks of an Oklahoma bomber pilot reflecting on his technician mentality which made it possible for him to drop bombs on the Vietnam countryside with little knowledge of the consequences for a native population. The role of the Japanese Suicide Corps is extremely important ideologically in positioning television as a humane response to an inhuman positioning of human subjects as expendable. Equally important are the recent reports of diaries of some of these pilots, declaring their opposition to Japanese fascism and the waste of their lives.

Similarly, Jon Else's "The Day After Trinity" presents a moment when physicist, David Wilson, a colleague of Robert Oppenheimer's at Los Alamos, remarks that the Nazi threat to Western civilization was regarded as so extreme that it motivated and justified the search for the atomic bomb. Once Germany surrendered, none of the scientists he knew at Los Alamos considered terminating the project; instead they bemoaned with Oppenheimer the government's failure to secure an international test ban treaty, as Oppenheimer put it, "the day after Trinity." Wilson's shoulder twitch in the recollection of this moment, his admitted vomiting the day he heard about Nagasaki, are moving moments of "The Day After Trinity," somaticizing feelings of political guilt into physical disturbance. Oppenheimer is more verbally eloquent perhaps, presenting his mea culpa; other physicists say he went too far in that expression or acknowledge his suffering as penance. The film's closing speaker describes the Faustian pact of the scientists, feeling the great allure of atomic weaponry. Their zeal expressed in the words of Oppenheimer's brother: our first response was "Thank God it worked" -- our second, "what have we done?" The tool of saving "Western civilization" became the instrument of Western racism: the "Yellow Peril" became the test site of atomic warfare.)

The scientist's responsibility and culpability in this high speed period of patriotic zeal in research is suggested in the words of the Deputy Director of the Office of Scientific Research and Development, Irvin Stewart, writing in the aftermath of the OSRD's disbanding and the early years of Cold War chill:

"Previous efforts to bring civilian science into the program of weapon development were based on the theory that the Services would know what they needed and would ask the scientists to aid in its development. Modern science has progressed to the point where the military chieftains were not sufficiently acquainted with its possibilities to know for what they might ask with a reasonable expectation that it could be developed. The times called for a reversal of the situation, namely letting men who knew the

latest advances in science become more familiar with the needs of the military in order that they might tell the military what was possible in science so that together they might assess what should be done. It was this conception which Bush and his colleagues sold to President Roosevelt and to which General Marshall and Admiral Stark gave their blessing prior to the issuance of the order of the Council of national Defense, which on June 27, 1940, established the National Defense Research Committee of the Council of National Defense."[16]

Zworykin and Sarnoff had already done this in 1934 when Sarnoff had taken his employee to officials of the Army and Navy with "the flying torpedo with electric eye". RCA was created as a corporate entity endorsed by the federal government to provide an alternative to dependency on British trans-Atlantic cables during World War I. Congressional hearings in the late 1920's and into the 1930's on monopoly control of broadcasting must be viewed against the backdrop of this alliance. Sarnoff biographer, Eugene Lyons, describes RCA's involvement in military application of television before the U.S.'s entry into the war as perspicacious:

> In 1937 two years before war came and four years before America was sucked into its vortex, RCA built the first television system specifically designed for use by aircraft. Soon thereafter television reconnaissance equipment for airplanes was reduced to suitcase dimensions. In 1940 the company blueprinted a proposed flying-bomb design. A month before Pearl Harbor the first three guided missiles built by RCA for the Armed Forces were tested at Muroc Lake.
>
> Taking into account the lead-time between conception and production, it is obvious that the company had been at work on these and most of the other electronic weapons years before the advent of the war. Even before the United States was officially a belligerent, RCA had licensed more than 140 manufacturers under its patents, thereby, in Sarnoff's words, 'opening channels of supply for successful conduct of war.' In addition to its own enlarged facilities, the company was feeding work to scores of subcontractors and suppliers.
>
> As part of the process of streamlining for war production, RCA accelerated its timetable for centralizing all research enterprises, until then spread through half a dozen plants and laboratories. Princeton, New Jersey, was chosen as the site for a unified Research Center.[17]

Section 5.3 of the OSRD, the section appointed to coordinate research and development in television for military purposes was headed by O. E. Buckley, then president of Bell Laboratories. At its first meeting, December 18, 1942, the committee discussed its division assignment -- guided missiles -- but agreed to query appropriate groups in NDRC about telemetering and reconnaissance. It further decided to restrict its activities to those requested by the Army and Navy but thought this policy might change later with initiative undertaken in appropriate cases. The only contractor cited during Dr. Buckley's brief review of the guided missile research and testing was RCA, whose existing contracts he reviewed and agreed to expand upon at the second meeting with a representative of RCA present. [18]

On February 19, 1943 the OSRD assessed the commercial facilties and personnel for research and development in the field of television for military application for Rear Admiral J. A. Furer (no pun intended), Department of the Navy. The RCA-NBC group was described as having "done more research and development in television than any others listed. . . . This group works in all aspects of the television art from the most fundamental research through to field application. The work which they have already done on military applications of television gives them a familiarity with the problems which is not equalled by that of any other concern. Their capabilities are so well known that further desription is not called for." [19] This assessment of their preeminent value to the OSRD was followed by an assessment of the other half of the partnership.

"I have the impression that the effectiveness of this group in the present situation can be improved by better planning on the part of NDRC of the research program sponsored by that organization. Steps are being taken by Section 5.5 (the television section of OSRD) to set up a well organized program of research and to coordinate it with the related activities of the Services."[20]

In 1941 Vannevar Bush, Chairman of the NDRC, had issued a memorandum to the members of the NDRC organization on the subject of placing contracts which seemed to encourage diffusion rather than concentration of government resources across the industry, the pressure to excel placed this goal in contradiction:

> ...The Commitee has endeavored to arrange for research to be done wherever practical in institutions which had not already been engaged in research efforts connected with national defense. Obviously in the application of this principle care must be taken that progress is not delayed. Where one organization is outstandingly qualified to conduct a particular piece of research, the problem is turned over to that organization even though it may have other defense research work under way.
>
> On the other hand, as between two or more organizations approximately equally well qualified to engage in a particular piece of research, preference is given to that organization which does not have other defense research activities under way.
>
> In recommending contracts in the future, it is desirable that where other things are equal, preference be given to qualified institutions which are not currently engaged on national defense research work.[21]

RCA received the lion's share of government contracts in television,[22] a fact made more interesting by the knowledge that through the 1930's RCA subcontracted its television aircraft equipment work to other manufacturers. In 1936 on Sarnoff's initiative the Radio Manufacturer's Association set up a committee which represented the principal producers to study available standards in an effort to reach consensus for the industry. RCA's subcontracting helped it marshall the support of a number of manufacturing firms engaged in a bitter war over technical specifications for television. On December, 1937 they sent their findings to the FCC. Few people were surprised that the standards accorded fully with the apparatus and recommendations of RCA, which had done the basic research and testing and held a large majority of the necessary television patents.

Sarnoff went public with his standards and commercial product at the 1939 New York World's Fair, with the RCA Exhibit Building featuring television technology that stimulated enormous popular interest. In the spring of that year and months following hundreds of thousands of visitsors to the Fair from all over the country were able to see television in operation for the first time. On April 30, 1941 the FCC authorized unrestricted commercial television development but the entry of the United States placed a halt on commercial domestic broadcast program development.

At the close of the war the first National Electronics Conference met in Chicago to provide a new mechanism, correlating the advances in all branches of electronics. "During the spring of 1944 a desire for action appeared spontaneously and simultaneously in several educational and engineering groups in Chicago where a vast program was under way for the production of wartime electronic equipment." With a registration of over 2000 engineers and academics, the conference featured Ralph R. Beal, assistant to the Vice President in charge of RCA Laboratories, to address the assembly. "Out of the preparedness of our research scientists and engineers in electronics have emerged new and vital weapons and new means of speeding industrial output. . . . We must be quick to recognize that if science can be so effective in war, it can be even more effective in peace. . . . [industrial television] envisages the use of radio sight as the 'eyes' of factories, the means of coordinating and controlling giant manufacturing enterprises, and the means also of looking into places that otherwise might be inaccessible or dangerous to man. Industrial television may be used by the plant manager to observe critical operations. It may be used to follow the flow of materials and observe progress of work. It may be used in chemical reaction chambers to make visible complicated chemical processes." While the motion picture of World War II experience moved into sales, Beal's television carried the eyes of management from front offices onto the shop floor just as receivers reached out into millions of American homes with their sales messages.[23]

With the corporate state experience in recent memory and function, Beal closed his address with the following appeal:

> Industrial research must never relinquish its harmonious cooperation with the Army and Navy. Science, which has helped win the war, must continue to assist in preserving the peace. If our armies, battleships and bombers are equipped with the latest devices of science, no nation will be anxious to seek a fight. Our armor of science must be strong.
>
> We know how destructive the weapons of science have been in this war. We know what the robot bomb has done; it makes us shudder to think what might happen were additional forces of science harnessed to its deathly wings. I can tell you, without revealing any military secrets, that based upon what I have seen developed for warfare in the science of radio-electronics

alone, another war would be much more destructive.
It is my urgent plea that our industrial research laboratories continue to work hand in hand with our Army and Navy in peace as they have done so magnificently in war. Let us through science put new power behind the wings of the dove of peace. That is the new challenge; it is our duty.[24]

Four months before the October, 1944 conference, Beal had published an article in Electronics called "Electronic Eyes for the Works Manager,"[25] in which he described the way television could monitor factory operations from a centralized fixed point allowing "the foreman to save time." Several articles in other management and scientific journals solidified the extension of Taylorist principles of 'scientific management' through television.[26]

RCA came out of the war the largest contractor with the OSRD for military television and a high profile patriotic industrial servant. Its major public relations campaigns won, RCA received results of the January 1945 FCC hearings and demonstrations, reaffirming their prewar specifications. With respect to CBS' demand (CBS had secured a contract under $20,000 to compare television cameras for certain OSRD specifications), the agency ruled that television could not 'be held in abeyance until a wide-channel system in the ultra high frequencies can be developed and proved.'[27] CBS' contention that color was around the corner and therefore specifications should be deferred until the 1950's fell on deaf ears. Of the soaring television sales from 5,000 in 1946 to 5 million in 1950, RCA accounted for more than half national sales. By 1949 television sales were the largest single category of RCA income. In September, 1948 Fortune magazine claimed, "It is difficult to dodge the profane thought that RCA stands to make a pile of money out of the television industry." (Why did Fortune find this 'profane' in 1948?)[28]

This information can, and has, as easily been amassed to prove RCA's patriotic devotion as its contribution to the Corporate State in the formulation of policy and technological direction. One can still say, "the technology is neutral." Its goodness or badness is a function of the hands in which it is placed, not anything intrinsic to the technology per se.

I would argue that the essence of televisual design in the United States is its one-way-ness and its capacity for remote control both in terms of sales persuasion and control in non-peer power relations. In Autonomous Technology,[29] Langdon Winner examines language and intellectual and ideological attitudes that have belonged to the West, to Europe and the United States for hundreds of years. Winner demonstrates the 'dominion' orientation of technology in Patriarchy, a project David Noble is currently engaged in extending. My previous work on the social context of television invention [30] follows the premises of Hans Magnus Enzensberger[31] that emancipatory technology is not simply small-scale, following Schumacher and Mumford, but two-way communication. Enzensberger and Michel Foucault both have revived interest in Jeremy Bentham's concept of the panoptikon as an instrument of social control; their allusions to the political realities of this equipment illucidates the television monitor in home and workplace.

Cultivated in the context of commercial sales and military control, television is not ideologically and politically neutral. Unlike two-way television which fared better in Great Britain with its stronger, less marginalized tradition of amateur and inter-personally oriented community-based communications (see Mary Douglas and Baron Isherwood The World of Goods for diffusion studies of television and telephone in Great Britain and their anthropological explanation for resistance to this innovation[32]), militarily informed television was designed for covert action and restricted participation in the production of messages: the entrenchment, as Raymond Williams' described it several years ago[33], of the centralization tendency in industrial societies, the solidification of one-way communication and 'remote control.'

FOOTNOTES

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15 Ibid., p. 93.

16 Irvin Stewart, Organizing Scientific Research for War. Boston: Little, Brown and Co., 1948. p. 6.

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18 Minutes of First Meeting, December 18, 1942, National Defense Research Council, Section 5.3, Record Group 227, NNFN(S), National Archives, Washington D.C.

19 Letter to Rear Admiral J. A. Furer, U.S. N.,, February 19, 1943, Record Group 227, NNFN(S), National Archives, Washington D.C.

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25 Beal, "Electronic Eyes," p. 278.

26 "Remote Viewer Represents Television's Entry into Industry," Scientific American, Vol. 176, (March, 1947), p. 126. "Industrial Television Can Serve to Improve Process Control," Scientific American, Vol. 171, (July, 1944), p. 36.

27 Lyons, op. cit., pp. 276-277.

28 "The Promise of Television," Fortune, Vol. 28, No. 2, (August, 1943), pp. 141-144.